MOVEMENTS OF *BANDICOTA BENGALENSIS AND NESOKIA INDICA* IN RICE FIELDS IN SIND[1]

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(*With a text-figure*)

Data on the movements of four adults of *Bandicota bengalensis* and two adults of *Nesokia indica* were gathered with radio telemetry equipment in rice fields shortly before and after harvest. Before harvest, a male *Bandicota* had a large home range (105 metres in diameter) enclosing the ranges of two or more females whose burrows he occasionally visited. Female *Bandicota* had ranges 22 and 30 metres in diameter. Two *Bandicota* moved away in response to the harvest operations, one moving 590 metres, the other 240 metres. Both moved to unharvested fields. No animal stayed in its home field more than two days after the harvest. Both *Nesokia* showed a pattern of shifting their home ranges every week or two to an adjacent, but non-overlapping area.

The Bandicoot Rat, *Bandicota bengalensis*, is well adapted to exploit an ephemeral and localized supply of abundant food, such as a ricefield (Fulk *et al.* 1981 ; Chakraborty 1977). Studies of the movements of *Bandicota* are of special interest since wild populations of this species do not usually live in the same place year around and individuals must move great distances to find new food sources. Frantz (1973) found that the pattern of movements in Bandicoot Rats in Calcutta was such that it enabled individuals to find quickly godowns recently filled with grain.

Earlier (Fulk *et al.* 1979) we reported on the movements of *Bandicota bengalensis* in a fallow field. We found that many of the animals moved long distances (up to 640 metres), not as part of their daily routine, but rather as a shifting of the home site. Here, we report on another study of the movements of *Bandicota*, this one carried out in a rice field shortly before and after harvest, undertaken in order to confirm the previous results and to learn how the pattern of movements might be affected by the different environmental conditions.

We also used this opportunity to follow the movements of *Nesokia indica*, a common but rarely studied rice field rodent in Sind.

Methods

Seven rodents (3 *Nesokia* and 4 *Bandicota*) were live trapped between 25 and 29 September 1978 in a rice farm (24°40′N-60°50′E) in Badin District, Sind Province, Pakistan. At this time, the crop was flowering. These animals were fitted with radio transmitters (AVM Instrument Company, Champaign, Ill., U.S.A.) and released at their points of capture after a 24-hour recovery period. Two additional *Bandicota* were caught and fitted with transmitters in October.

We used a vehicle-mounted antenna which could pick up the signal from a distance of 500 metres when the animal was on the surface, but only from 100 to 200 metres when the

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animal was in a burrow. All final fixes (determinations of an animal's location) were made by approaching the animal with a hand-held antenna.

Starting on 1 October, we made eight trips to the farm and followed the animals on 21 mornings and evenings in October and 8 mornings and evenings in November. Fixes were made at hourly intervals from sunset to midnight or later. Whether the rat was inside or outside a burrow was recorded for each fix. Whenever a signal could not be received, traps were set around the last location site and the surroundings were searched with the vehicle-mounted antenna. More than four square kilometres had been thoroughly searched by the end of the study.

Fluorescent tubes were fixed to some transmitter collars as suggested by Taylor (personal communication) in order to permit sighting of rats at night. This technique failed, probably because of the dense cover of vegetation.

Results

Signals from one *Bandicota* were never received. Little data on two other animals (one *Bandicota* and one *Nesokia*) were gathered since their transmitters were found on the ground 25 and 52 metres from the release points soon after release. These animals were probably killed by predators. Both of the transmitters had tooth marks and one was found near pieces of fur and meat. We had live-trapped a mongoose (*Herpestes auropunctatus*) in these fields.

Data from the remaining animals are summarized in Table 1 and presented below. Figure 1 shows the home ranges and long distance movements made by some animals.

Table 1

Summary of radio-telemetry study of *Bandicota bengalensis* and *Nesokia indica* in rice fields

Animal				Days Followed	Long Distance Movement (Metres)	Observed Range Length (Metres)	Remarks
No.	Species	Sex	Weight (Grams)				
1	*N. indica*	M	140	4	—	11	Transmitter found
2	*N. indica*	M	145	27	—	37	Disappeared
7	*N. indica*	M	104	14	—	18	Disappeared
4	*B. bengalensis*	F	180	11	—	22	Disappeared
5	*B. bengalensis*	F	148	27	45	30	Disappeared
6	*B. bengalensis*	M	280	0	—	—	Transmitter found
8	*B. bengalensis*	M	140	0	—	—	Disappeared
9	*B. bengalensis*	M	250	23	240	105	Disappeared
10	*B. bengalensis*	F	200	30?	590	?	Transmitter found

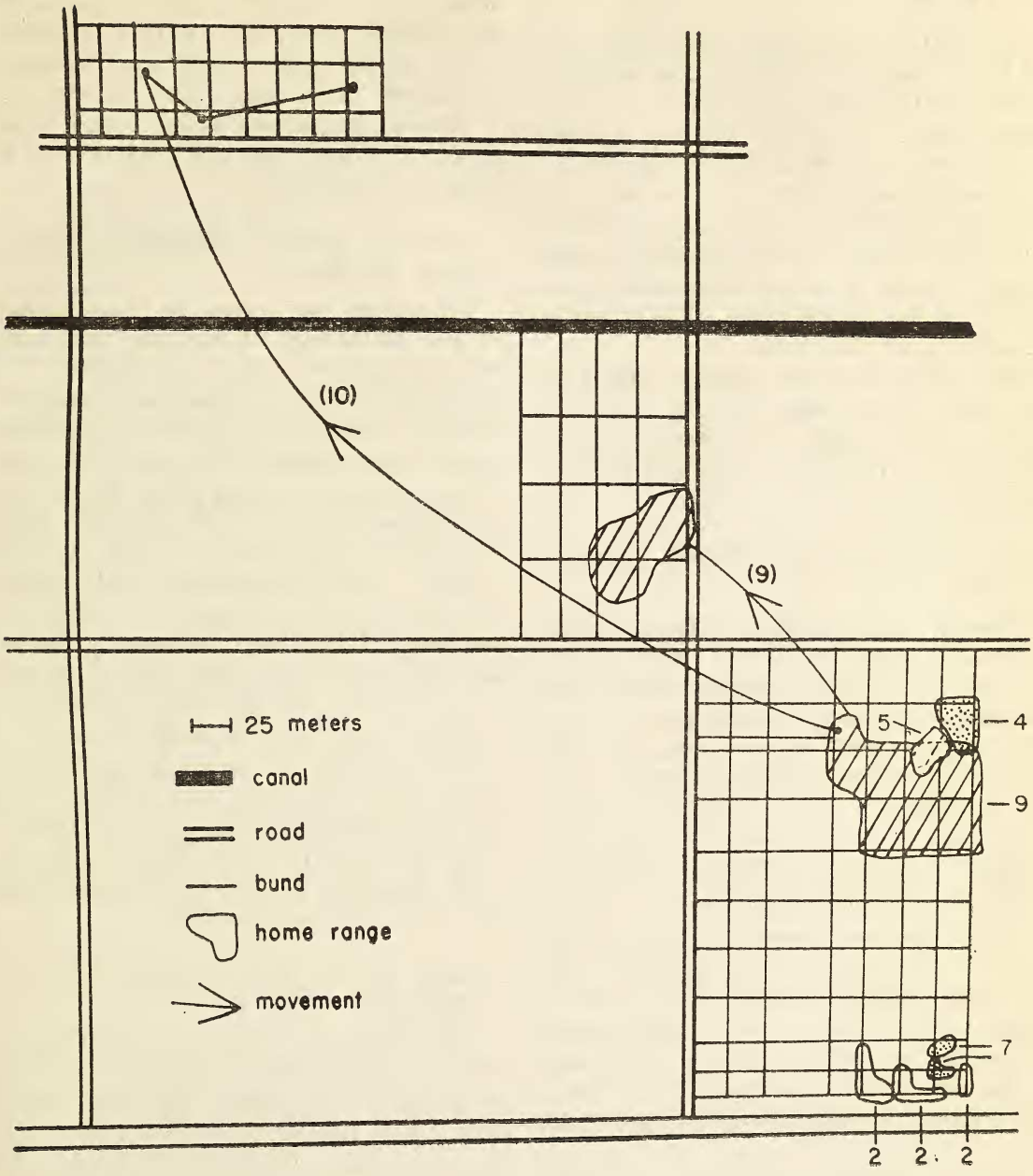

Fig. 1. Map of farm where movements of two *Nesokia indica* (numbers 2 & 7) and four *Bandicota bengalensis* (females 4, 5 & 10 and male 9) were followed with radio telemetry. The entire farm was divided into rice fields, but separate fields are shown here only for part of the farm.

NUMBER 2, *Nesokia indica*, SCROTAL MALE, 145 GRAMS.

On 2 and 3 October, this animal was located 13 times, mostly in its burrow, but sometimes moving on the surface in the rice or along the bund. Between 4 and 20 October, it shifted its home range and frequented two new burrow systems (38 fixes). Although close by, it did not appear in the former home range. Between 22 and 25 October, it again changed its home range (18 fixes) to a field about 45-50 metres away from the original home. The reason for these shifts are not known.

The Observed Range Lengths (ORL) for these three home ranges were 37, 35 and 22 metres. On the night of 25 October, this rat disappeared. These fields were harvested two days later.

NUMBER 7, *Nesokia indica*, SCROTAL MALE, 104 GRAMS.

Between 1 and 4 October, this rat was located 14 times in a small area. From 8 to 12 October, it was located 25 times in another area, nearby but not overlapping with the previous area. No disturbance apparent to us caused this shift. On the night of 16 October, this animal could not be located.

NUMBER 4, *Bandicota bengalensis*, PERFORATE FEMALE, 120 GRAMS.

This female was located 22 times between 1 and 9 October and was very active. She frequently crossed the width of the field, a distance of 19 metres, in a few minutes. During the day, we saw runways and damage in the field near her home burrow. During the night of 9 October this animal disappeared.

NUMBER 5, *Bandicota bengalensis*, PERFORATE FEMALE, 148 GRAMS.

The home range of this female was adjacent but exclusive to the range of animal Number 4. Most of the 58 fixes for Number 5 were in the home burrow, but sometimes this animal moved on the surface, one evening as far as 45 metres away, considerably beyond her previously established home range. On the night of 25 October, it disappeared and was not found again. Two days later, the fields around its burrow were harvested.

NUMBER 9, *Bandicota bengalensis*, SCROTAL MALE, 250 GRAMS.

This animal was located 34 times between 11 and 24 October. It was very active and travelled distances up to 50 to 60 metres in a few minutes. Its total home range comprised an area of 0.68 hectares. In this area, 5 burrow systems were visited 2 to 6 times each. One of these systems was used in the daytime and was situated at the edge of the home range. Out of the 4 other burrow systems, two were known to contain an adult female and juveniles. While the harvest operations were going on, this animal limited its movements to the unharvested parts of its range. On the evening of 24 October, a few days after the harvest of all fields within its home range, it moved to unharvested fields 240 metres away. Here, it established a new home range of about 0.2 hectares and remained there between 20 October and 3 November (9 fixes). When we checked on 14 November, the fields had been harvested and this rat had disappeared.

NUMBER 10, *Bandicota bengalensis*, FEMALE, 200 GRAMS.

This animal was released on 22 October. Several juveniles were also captured near the home burrow of this animal which had enlarged teats. Male Number 9 visited this burrow at least three times. On 23 and 25 October, this female was located 12 times, always inside her burrow. Two days after the harvest of the fields around her burrow, she moved away. On 30 October, after considerable searching, we

TABLE 2

PER CENT OF TOTAL RADIO-TELEMETRY FIXES THAT WERE ON THE SURFACE AS OPPOSED TO IN A BURROW FOR 6 RODENTS IN RICE FIELDS. VERTICAL LINES CONNECT VALUES THAT ARE NOT DIFFERENT AT $P > .05$

Individuals				Species Totals		
Animal Number		Total Fixes	% on Surface	Species	Total Fixes	% on Surface
Bandicota male	9	49	82	*Bandicota bengalensis*	164	43
Bandicota female	4	22	64	*Nesokia indica*	102	19
Bandicota female	10	16	31			
Bandicota female	5	77	14			
Nesokia male	2	68	21			
Nesokia male	7	34	15			

located this animal in a burrow in the middle of an unharvested field 590 metres away from the previous burrow. On 1 November, this field was harvested; and on the evening of 2 November, the female moved about 60 metres to a neighbouring, partly-harvested field. It stayed there only a few hours and by the next morning had moved about 100 metres to a burrow in a grassy bund. On the way, it had crossed several open fields. It stayed in this burrow, apparently without moving. We dug out this burrow on 26 November and found the radio transmitter without the animal. Probably it had been eaten by a predator.

Surface Activity

Two bandicoots, male Number 9 and female Number 4, were more likely to be found on the surface than the other animals (Table 2). Overall, 43% of the *Bandicota* fixes were on the surface compared to only 19% of the *Nesokia* fixes.

DISCUSSION

Only three of nine transmitters were recovered. Transmitter break down, caused either by predation or battery failure, could have accounted for some of the remaining six. However, we feel that most of these animals moved outside of our searching range. That bandicoot rats can and do move considerable distances was shown by female Number 10, which moved a straight-line distance of 590 metres, and male Number 9, which moved 240 metres. This result is similar to our earlier study in which several bandicoots moved long distances (Fulk *et al.* 1979).

The animals fitted with the three transmitters that were found were almost surely killed by predators. The two that were found soon after release had fluorescent tubes fixed to their collars. Perhaps these tubes made animals more susceptible to nocturnal predators.

Movements of two bandicoots were definitely affected by the harvest operation, while two others (*Nesokia* 2 and *Bandicota* 5) may have been affected. No animal remained in its home field for more than a few days after harvest. This is somewhat surprising in light of our past experience (Fulk *et al.* 1981) that *Bandicota* may remain abundant in rice fields after harvest, especially if rats store rice underground. We

inspected several burrow openings after the harvest in this study and found no evidence (scattered rice pannicles) that rats had stored rice. We excavated one burrow, that of *Bandicota* Number 10, and found no stored rice. Why *Bandicota* stores rice underground on some occasions and not on others is unknown. We did feel that rat density had been unusually low in these fields.

In our previous study (Fulk *et al.* 1979) as in this study, we observed that a male *Bandicota* had a large home range encompassing ranges of two or more females.

The data we gathered on *Nesokia* showed that some individual *Nesokia* may be as active on the surface as some *Bandicota* are, at least near the time of harvest. This corresponds well to our finding (Fulk *et al.* 1981) that *Nesokia* does eat rice grain at this time, but is in contrast to the opinion of Wagle (1927) that *Nesokia indica* was ' quite innocent of damaging the rice crop '.

We observed in both individuals of *Nesokia indica* a pattern of shifting the home range to an adjacent but non-overlapping area. One can only speculate as to the cause of this behaviour. Perhaps *Nesokia* moves to a new area when its principal food, roots of certain grasses and sedges, becomes locally exhausted.

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